

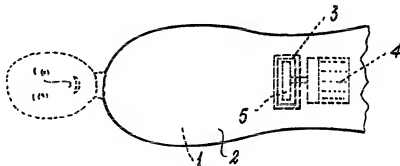


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/EP96/03132 <b>(22) International Filing Date:</b> 17 July 1996 (17.07.96) <b>(30) Priority Date:</b> M195A001629 26 July 1995 (26.07.95) IT <b>(71) Applicant (for all designated States except US):</b> PHARMACIA & UPHOHN S.P.A. [IT/IT]; Via Robert Koch, 1,2, I-20152 Milano (IT). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> ROVETTA, Alberto [IT/IT]; Via Andrea Doria, 28, I-20124 Milan (IT). PAGANI, Massimo [IT/IT]; Via Ferraris, 43/6, I-20021 Bollate (IT). DEI CAS, Livio [IT/IT]; Via Milano, 8, I-23032 Bormio (IT). PEDEVILLA, Marco [IT/IT]; Via Domodossola, 11, I-20145 Milan (IT). MARTININI, Stefano [IT/IT]; Via Giuseppe Ferrari, 18, I-20154 Milan (IT). <b>(74) Agents:</b> FRIGNOLI, Luigi et al.; Ing. A. Giambrocono & C. s.r.l., Via Rosolino Pilo, 19/B, I-20129 Milan (IT).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LK, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG). Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM). European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). <b>Published</b> <i>With international search report.</i>

**(54) Title:** MANIKIN FOR SIMULATING CARDIAC PATHOLOGIES**(57) Abstract**

A manikin for simulating cardiac pathologies and usable for training cardiologists, the manikin comprising a profiled shell externally covered by an elastic membrane and internally housing at least one electromechanical transducer arranged to transmit pulsations of variable frequency and variable amplitude to a defined area of said membrane, the transducer comprising a cam carried by an electric motor rotatable in one direction and in the other direction to cause said cam to undergo rotations of less than 360° in amplitude.



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## MANIKIN FOR SIMULATING CARDIAC PATHOLOGIES

The invention relates to a manikin able to simulate cardiac pathologies and usable for the training of cardiologists.

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In training students and cardiologists, the ideal would be to have available persons with the most varied cardiac pathologies to be able to observe the different specific symptoms for each pathology. In practice this possibility does not exist, with the result that training is necessarily superficial or incomplete and in any event unsatisfactory.

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To overcome these problems, manikins have been constructed incorporating some resemblance to the trunk, the arms and the head of an actual person. These manikins house sensors and transducers which, for the principal points of the manikin, enable sounds and movements characteristic of the most diverse and typical pathologies for these points to be generated. The sounds can be detected by a stethoscope, the movements being detected either by direct observation or by palpitation.

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Manikins of this type are described in the patents US-A-3,662,076, US-A-3,888,020, US-A-3,947,974, US-A-4,601,665, US-A-4,828,501, US-A-4,932,879, GB-A-2,193,029 and EP-A-0,561,658.

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In addition to describing devices arranged to emit sounds detectable by a stethoscope and electromechanical transducers arranged to impart movements to well defined zones of the manikin's surface, these patents illustrate the most varied systems (controlled by recorders or computerized systems) for

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obtaining the desired sound emission or the required sequence of movements at the various points of each manikin, on the basis of the pathology to be simulated.

- 5 Limiting our attention to the system for transmitting movement to those zones of the manikin which are of interest, it will be noted that US-A-3,662,076 describes a series of cams driven continuously always in the same direction by a variable speed electric motor, these cams comprising pumps which transmit an oscillatory movement  
10 to pistons positioned below and in contact with an elastic membrane simulating the manikin's skin; US-A-4,601,665 describes a system in which the pistons positioned below and in contact with the manikin's "skin" consist of the rods of electromechanical transducers in which the same rods form part of a permanent magnet  
15 or a ferromagnetic material able to traverse telescopically within the cavity of a solenoid through which an electric current fed by the control system for this device flows; and GB-A-2,193,029 describes a manikin construction in which different constituent parts of the chest of the manikin are mounted on pins on which  
20 they can be made to rock between two positions by electromagnetic attraction.

All the stated manikins can be easily controlled to transmit oscillations of fixed or variable frequency to the manikin's  
25 "skin", but none of them enables the amplitude of the mechanical oscillation of the manikin's "skin" to be varied when required, and in a very simple manner, in correspondence with the zone in which the relative electromechanical transducer is positioned.

- 30 The main object of the present invention is to provide a manikin for cardiac pathology simulation, which is able to transmit to selected zones of the manikin's "skin" mechanical oscillations of frequency and especially amplitude variable between a minimum and a maximum compatible with the pathology to be simulated.

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A further object is to provide a manikin of the aforesaid type which is of simple and economical construction and of reliable

operation.

These and further objects are attained by a manikin comprising a profiled shell externally covered by an elastic membrane and internally housing at least one electromechanical transducer acting on a limited zone of said membrane to transmit pulsations thereto consequent on electrical pulses fed to said transducer by a computerized generator, characterised in that said electromechanical transducer consists of a cam carried by an electric motor rotatable in one direction and in the other direction to cause said cam to undergo rotations of up to 360° in amplitude.

Preferably said motor is an induction motor with a static frequency converter which feeds the motor with a sinusoidal voltage of adjustable amplitude and frequency.

The structure and characteristics of the manikin according to the invention will be more apparent from the description of one embodiment thereof given hereinafter by way of non-limiting example with reference to the accompanying drawing, in which:

Figure 1 is a schematic view from above showing the manikin covered by the elastic membrane simulating a patient's "skin".  
Figure 2 is a longitudinal section through the manikin; and  
Figure 3 is a cross-section through the manikin on the line 3-3 of Figure 2.

The manikin shown schematically in the drawings comprises a profiled shell (constructed for example of aluminium, sheet steel or synthetic material) 1 simulating a human thorax and covered externally by an elastic membrane 2 simulating the human skin.

Apertures are provided in the shell in correspondence with zones in which it is desired to observe movements typical of certain cardiac pathologies. For simplicity, only one of these apertures is shown on the drawing, positioned in correspondence with the

diaphragm and housing a movable plate 3, but further apertures can evidently be provided, for example in correspondence with the ictus.

- 5 Within the thoracic cavity bounded by the shell 1 there is housed a geared motor 4, on the output shaft of which there is keyed a cam 5. The motor is constructed such as to be able to transmit to the relative cam a rotation in one direction or the other, at a variable frequency and with a variable angle of rotation which, in  
10 the illustrated example, has a maximum amplitude of 180 °.

- The motor 4 is preferably of the single phase or three phase induction type, with a static frequency converter which, by means of an inverter circuit of pulse width modulation type, provides  
15 the motor with a sinusoidal voltage of adjustable amplitude and frequency, this not being described herein for simplicity and because it is of known type easily implemented by a normal expert of the art.
- 20 Using a computer fed with a suitable program (easily conceived by a normal expert of the art and in fact totally similar to the analogous arrangements described in detail in the prior patents cited in the introduction to this description), when the desired succession of pulses is transmitted to the motor 4, the motor  
25 causes the cam 5 to oscillate in one direction and in the other direction alternately, at the desired frequency, making it rotate through a maximum of 180° between the dashed-line rest position indicated by the letter C in Figure 3, and the position of maximum lift of the diaphragm shown by a full line and indicated by the letter A in the same figure, by passing through the intermediate  
30 positions B.

- The shape or contour of the cam either causes the diaphragm to rise to its maximum extent or causes it to rise to a predetermined  
35 extent (less than the maximum).

Summarizing, it can be seen that with the described system the

diaphragm can be raised and lowered to the extent and with the frequency typical of the pathology to be simulated.

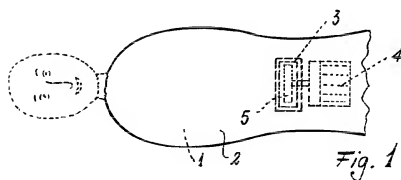
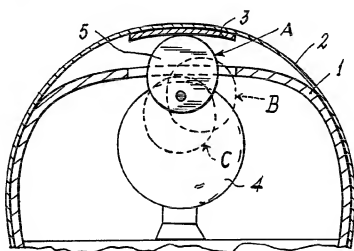
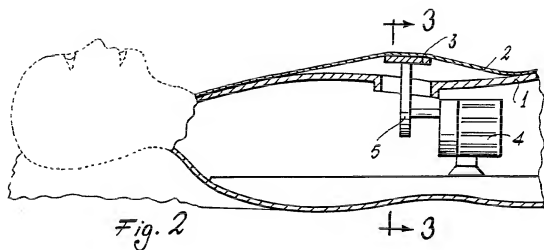
- In the embodiment shown on the drawing, the elastic membrane 2 acts as a spring for maintaining the plate 3 pressed against the cam surface. Constructional modifications can be adopted aimed at limiting the friction and wear between the cam and plate. For example the cam can be housed within the inner cage of a rolling bearing, the outer cage of which is fixed to the movable plate.
- 10 Alternatively, between the plate and cam there can be interposed an intermediate element with springs which maintain the plate always urged towards the cam surface.

## Claims:

1. A manikin for simulating cardiac pathologies, comprising a profiled shell externally covered by an elastic membrane and  
internally housing at least one electromechanical transducer  
acting on a limited zone of said membrane to transmit pulsations  
thereto consequent on electrical pulses fed to said transducer by  
a computerized generator, characterised in that said  
electromechanical transducer consists of a cam carried by an  
electric motor rotatable in one direction and in the other  
direction to cause said cam to undergo rotations of up to 360° in  
amplitude.
2. A manikin as claimed in claim 1, characterised in that  
said motor is an induction motor with a static frequency converter  
which feeds the motor with a sinusoidal voltage of adjustable  
amplitude and frequency.



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## INTERNATIONAL SEARCH REPORT

Intern. Application No.

PCT/EP 96/03132

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 G09B23/28 G09B23/32

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB,A,1 291 198 (RESEARCH CORPORATION) 4 October 1972 see page 1, line 75 - page 3, line 57 see page 3, line 103 - page 4, line 18; figures 1-7 & US,A,3 662 076 cited in the application ---	1
A	EP,A,0 561 658 (F.M.C. PRODUCTION) 22 September 1993 cited in the application see column 2, line 44 - column 3, line 36 see column 6, line 49 - column 7, line 17; figures 1,2 ---	1
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 601 665 (FRANCIS B. MESSMORE) 22 July 1986 cited in the application see column 3, line 21-47; figures 2,3 -----	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Application No

PCT/EP 96/03132

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-1291198	04-10-72	US-A- 3662076	09-05-72
EP-A-561658	22-09-93	FR-A- 2687492	20-08-93
		US-A- 5397237	14-03-95
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